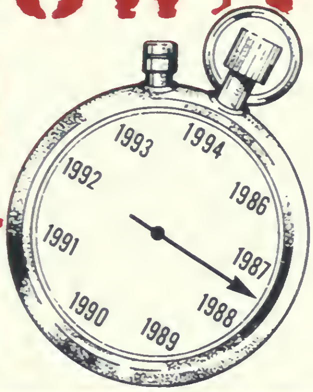
646 E

COUNTDOWN ACID RAIN



Summary and Analysis of the Second Progress Reports by Ontario's Four Major Sources of Sulphur Dioxide

Ontario
Ministry
of the
Environment

[redacted]

Rod McLeod
Deputy Minister

COUNTDOWN ACID RAIN

SUMMARY AND ANALYSIS OF THE SECOND PROGRESS REPORTS BY ONTARIO'S FOUR MAJOR EMISSION SOURCES OF SULPHUR DIOXIDE

- COUNTDOWN ACID RAIN -

SUMMARY AND ANALYSIS OF THE SECOND PROGRESS REPORTS BY ONTARIO'S FOUR MAJOR EMISSION SOURCES OF SULPHUR DIOXIDE

INTRODUCTION

Ontario's Countdown Acid Rain program was announced in December 1985. Under this program, province-wide emissions of sulphur dioxide (SO_2) are being cut to 885 kilotonnes (thousand metric tonnes) by 1994, compared to the 1980 base case level of 2,194 kilotonnes. It is hoped that our American neighbours will take comparable action so they in turn will reduce the 50% of Ontario's acid deposition which originates in the United States.

Four corporate sources produce about 80% of the SO_2 emissions in Ontario. As part of Ontario's Countdown Acid Rain program regulations were passed for each of these sources requiring staged reductions between 1986 and 1994. A key feature of the regulations is the requirement for regular progress reports each six months, leading up to a final report by 31 December 1988 showing precisely which abatement methods and technologies have been chosen. A complete description of the program can be found in the Countdown Acid Rain information kit.

The four major SO_2 sources are Inco Ltd. and Falconbridge Ltd. in Sudbury, Algoma Steel Corporation Ltd. in Wawa, and Ontario Hydro (all its fossil-fuelled plants). The first three corporations are required to submit technical progress reports every six months, and Ontario Hydro has agreed to provide comparable information.

The 1986 SO_2 emissions of all four companies were a total of 294 kilotonnes (kt) below the 1389 kilotonnes permitted.

	1986 Legal Limit (kt)	Actual 1986 Emissions (kt)	Percentage of Annual Limit (%)
Inco	685	635	92
Hydro	370	270	73
Algoma (Wawa)	180	100	56
Falconbridge	154	90	58
TOTALS	1,389	1,095	79

REPORTS AND RESPONSES

Each of the four major SO_2 sources has submitted its first and second report to the Minister of the Environment, showing progress to date and plans for the future. The complete text is available from the Ministry. The reports have been analysed and a response formulated. A summary of each company's second report, prepared by the Ministry of the Environment, is followed by the government response.

Each of the corporations has complied with the legal requirements, both in meeting the emission limits and in reporting on abatement developments. It is clear that technical progress continues to be made across a broad front. Detailed financial information is still not available for most of the needed technical changes, but this is reasonable in view of the fact that much of the developmental work has not been completed, and certain final decisions await the results of commercial-scale testing. It is expected that more detail will be available in subsequent reports as the results of the various tests become available. The final reports from the corporations, which are due when the three year technology development period ends December 31, 1988, must contain the technical and financial details showing how the emission reductions will be accomplished.

SUMMARY OF INCO'S SECOND PROGRESS REPORT

Inco operates a large nickel/copper smelter with associated mining and milling, and produces sulphuric acid from the sulphur contained in the ores. The company was required by the December 1985 regulation (O. Reg 660/85) to limit its SO_2 emissions to 685 kt in 1986 and to 265 kt by 1994. Inco is also required to examine the possibility of reaching a limit of 525 kt by 1990 and 175 kt at an unspecified date.

The second report indicates the current research and testing program continues to be focused on improving the rejection of the sulphur in the crushed ore before it enters the smelter, while at the same time increasing the metal concentrate grade and minimizing the loss of metal in the rejected material which goes to the tailings ponds. Insofar as these two approaches are successful, more of the sulphur captured from the hot gases will originate from the ore stream which contains most of the nickel and copper, and less from the roasting of currently non-economic pyrrhotite (an iron sulphide rock containing small amounts of nickel, copper and cobalt). A smaller amount of new acid plant capacity at a lower cost would then be needed to meet the SO_2 emission targets. This is desirable because sulphuric acid is currently an unprofitable by-product.

Over the past five years, productivity in the smelter has been greatly improved as a result of a number of technical changes. Inco's objective in developing solutions to the SO_2 emission reduction requirements is to utilize these efficient facilities to the maximum, and to avoid the construction of a new smelter, which, based on Inco studies, would not be cost justifiable.

Two major technical processes and several other changes are being actively pursued. However, the company appears to be focusing on the bulk smelting process.

1. New Pyrrhotite Rejection System

A complex new patented flotation system, designed to separate the sulphur-containing non-magnetic pyrrhotite while keeping the loss of valuable minerals to an acceptable level, is being further refined. This process reduces the amount of sulphur which would otherwise have to be converted to sulphuric acid at a later stage in the process.

Extensive pilot plant and laboratory testing continued on the rejection of non-magnetic pyrrhotite from the scavenger circuit at the Mineral Dressing Test Centre with technically encouraging findings being reported for:

- altering the position of sodium hydro sulphide addition,
- addition of a second thickener,
- reducing feed grinding,
- column vs. bulk flotation.

Construction is now underway to convert one sixth of the Copper Cliff Mill non-magnetic pyrrhotite circuit into a "test circuit". The majority of equipment to be used consists of surplus units. The 100 cubic foot Denver flotation cells have already been moved on site. The installation work is scheduled for completion by the end of March, 1987.

Rejected pyrrhotite is being directed to an impoundment area within the 2,000 acre tailings area in a manner which offers the potential for future recovery while offering long term protection to the environment. This management plan will provide for thirty years of operation.

2. Bulk Smelting

Currently, most of the nickel and copper move through separate circuits. Flash smelting of bulk concentrate (in which copper and nickel ores are smelted together) increasingly seems to be likely to become the cornerstone of Inco's smelter improvement/SO_2 abatement program. Related work includes:

- a new enclosed screw feed system (constructed),
- a new high velocity burner with natural gas assist (installed),
- a new oxygen injection system (installed at a cost of $634,000),
- modifications in the matte separation plant to handle increases in matte (completed at a cost of $322,000),
- a new 40 foot high flotation column (installed) and a second one is under construction.

Testing of flash smelting of bulk concentrate with pyrrhotite rejection and higher grade concentrate is rescheduled from just prior to the shutdown in the summer of 1987 to late 1987.

3. Other Changes

Other processes installed, studied or planned to meet the emission limits and to examine the possibility of lower interim levels and a final level of 175 kt of SO_2 include:

° reduction smelting - testing reverberatory furnace operations using high volumes of Iron Ore Recovery Plant calcine with reductant additions was completed and results are being interpreted;

- refinements of the hoods and flues to provide better management of flue gas from the converters and more consistent higher concentration SO_2 gas strength as needed for acid production;
- "semi-continuous" converting - following the review of this process as practised at Codelco's El Teniente smelter, Inco elected to stop further investigation of this option (it had been hoped this process might provide a more uniform SO_2 gas stream);
- since semi-continuous converting has been dropped, capture of converter gases using a third "stretched" 45 foot converter (now installed) no longer has a high priority in the company's development plan.

ONTARIO GOVERNMENT RESPONSE TO INCO'S SECOND PROGRESS REPORT

The technical committee which examined Inco's second report found that it complied with Regulation 660/85 and in general terms was informative. Unfortunately the government's review of the first progress report was not available to the company in sufficient time to permit the company to address the reviewers' suggestions in its second report. Other findings were:

- Commencing with the third report, Inco should provide the company's current projections for emission reductions expected for each process technology.
- The company's contingency plans, in the event that one or more of the planned tests does not meet expectations, have not yet been set out. It would be advantageous in this forum to know how Inco has addressed the abatement options described in the report of the Ontario/Canada Task Force on Inco and Falconbridge.
- A more specific timetable for the proposed research/testing, more independent of the pressures of normal production scheduling, would be useful. The timetable should indicate a reschedule test period if original test periods are not met, to ensure that Inco is in a position to report its final technology decisions by December 31, 1988.

SUMMARY OF FALCONBRIDGE'S SECOND PROGRESS REPORT

Falconbridge Ltd. operates a large nickel/copper smelter and ancilliary facilities and produces sulphuric acid from the sulphur contained in the ore. The regulation passed in December 1985 (O. Reg. 661/85) requires the company to reduce the SO_2 emissions from its Sudbury smelter complex to no more than 100 kilotonnes by 1994. The previous limit was 154 kt.

The second report confirms Falconbridge's five year research and development plan set out in the first report has not been changed. The envisioned methods to meet the new emission limit are a combination of:

- ° increased pyrrhotite rejection at the Strathcona mill;
- ° increased degrees of roasting in the fluid bed roasters in the smelter to produce additional sulphuric acid;
- ° converter slag cleaning improvements to increase metal recovery and full scale operation of the process.

1. Increased Pyrrhotite Rejection

The objective of the program is to reduce the nickel losses associated with the rejection of pyrrhotite from the milled ore. The physical separation of grains of pentlandite (the main nickel ore) from nickel bearing pyrrhotite is very difficult to achieve. Consequently, incremental improvements are being sought in several critical areas. Technical expertise is being assembled from inside and outside the company.

Commissioning and refinement of the new magnetic separation and flotation circuit on the scavenger concentrate at the Strathcona Mill continued. Work continues on non magnetics flotation, improved grinding and classification, improved flotation reagents, new flotation equipment and technology, flow sheet development, and computer modelling (material balance and techno/economic models).

2. Increased Degree of Roast

The objective is to develop and install a method to increase the degree of sulphur elimination during roasting and to capture the extra SO_2 as acid by utilizing the existing smelter installation.

Evaluation of the gas cleaning system, (August, 1986) suggested how to reduce inleakage of air into ducts from under the insulation and cladding. For the second finding (bypassing the secondary cyclones) engineering designs have been prepared and are under assessment. The test identified the mechanism of dust collection and crusting which led to a proposal for eliminating build-ups. Developmental work on acid gas capacity has been delayed six months.

The three year study to define the operative mechanisms of electric furnace smelting has been completed. Enhancements to smelting reactions were identified and work continues to develop them to their full potential.

The computer modelling and operational testing project to improve final product matte chemistry within the converter was successful. The resulting modifications to operating practices will be implemented in 1987.

ONTARIO GOVERNMENT RESPONSE TO FALCONBRIDGE'S SECOND PROGRESS REPORT

The technical committee found that the provisions of Regulation 661/85 were met and that the report was as informative and satisfactory as the first progress report. Unfortunately the government's review of the first progress report was not available to the company in sufficient time to permit a detailed response to the reviewers' suggestions in its second report. Other findings are:

- ° The company's continued emphasis on increased roast and pyrrhotite rejection is reasonable, particularly given present production emission levels as compared to the regulated limit.
- ° As Falconbridge has promised in the letter accompanying the report, subsequent progress reports will provide a breakdown of expected emission reductions expected from each proposed process.
- ° The company's objectives for concentrate grades should be described when the ongoing research is completed (in order to allow solid judgements of the proposed abatement measures).

SUMMARY OF ALGOMA'S SECOND PROGRESS REPORT

The Algoma Steel Corporation Ltd. operates an iron sintering plant in Wawa. Regulation 663/85 limits the SO_2 emissions from the operation to 180 kilotonnes per year in 1986 through 1993, and to 125 kt in 1994 and thereafter. The previously existing limit was 285 kt.

As of August 1, 1986, Algoma Ore Division has decreased its production capacity at Wawa from 2.0 million tons per year to 0.9 million tons per year. Consequently, SO_2 emissions will be maintained well below the 1994 requirement of 125 kilotonnes.

During 1984 and 1985 a pilot scale process was tested to remove sulphur from the ore before sintering. It was to be used in conjunction with increased low sulphur iron oxides (e.g., mill scale) to meet the emission limits. However, the capital and operating costs would be prohibitive at Wawa.

The second progress report confirmed that there had been no change to the economic realities facing the steel industry so the company would continue its Wawa operations at reduced capacity. Should market conditions change, the company would obtain ore from sources other than Wawa. In response to the comments from the analysis of the first progress report the company supplied figures for the volumes of low sulphur oxides used in its mill each year from 1980 to the end of 1986 and a calculation of the amount of sulphur dioxide which was not emitted from Wawa as a result. Algoma expects to continue to use approximately 80,000 tons of mill scale in 1987.

ONTARIO GOVERNMENT RESPONSE TO ALGOMA'S SECOND PROGRESS REPORT

The technical committee found that the requirements of Regulation 663/85 have been met with respect to the company's second progress report. Also noted:

° If economic conditions change and the company wishes to increase its production at Wawa again, utilizing any ore containing sulphur, technical reduction methods or procedures such as those previously examined would have to be in place before production could increase to a level which would in the existing facility, result in a violation.

ONTARIO HYDRO'S SECOND PROGRESS REPORT

Ontario Hydro is a publicly-owned utility which supplies almost all of Ontario's electricity needs. The corporation operates three large coal-fired plants in southern Ontario, and two smaller coal-burning plants in the northwestern part of the province. Other fossil-fuelled plants are currently moth-balled. Nuclear and hydraulic plants supply over two thirds of the electrical supply. The regulation passed in December 1985 reduced the SO_2 emission limits set by a prior regulation. The 1986 limit was reduced from 390 to 370 kilotonnes per year, the 1990 limit was reduced from 260 to 240 kt per year, and a new limit of 175 kt was imposed for 1994 and thereafter. A limit was also placed on the total of SO_2 plus oxides of nitrogen.

The regulation also establishes a "bank" of SO_2 emissions which Hydro may create and draw upon, only with the permission of the Minister of the Environment, in one year providing it operates below the legal limit in other years.

Hydro is required to report by December 31, 1988 on the methods to be used to achieve the emission limits, and the quantity of emissions which Hydro believes it should be allowed to withdraw from the bank. A separate provision of the regulation requires quarterly reports of actual emissions.

There is no requirement for semi-annual reports on technology research and development, as with the three other major SO_2 sources, but Hydro has agreed to provide comparable information on a voluntary basis.

SO_2 Emissions and Credit Situation

Hydro reports its quarterly SO_2 and NO_x emissions in a document separate from its progress report. The reported emissions are shown here for completeness. The 1986 emissions are 19% lower than Hydro's 1985 emissions. Total emissions for 1986 were made up of 270 kilotonnes of SO_2 and 50 kilotonnes of NO_x.

Quarter (1986)	Proportion (%)	Apportioned Emission Limit (kilotonnes)	Actual Emissions SO_2 (kilotonnes)	Contingency Bank * (kilotonnes)
1st	35	129.5	108.1	21.4
2nd	20	74.0	46.4	27.6
3rd	20	74.0	46.4	27.6
4th	25	92.5	69.1	23.4
	100	370.0	270.0	100.0

* Based on historical emission patterns the credit (or debit) is calculated by subtracting the actual emissions from the quarter's apportioned emission limit.

Abatement Measures in Place

Hydro's second progress report confirms that the corporation has an even wider portfolio of options under active consideration than were listed in its first report. It estimates that these options will contribute to meeting Ontario's electricity needs by some 5,660 MW as follows:

Additional Option	Contribution
Conservation	3,200 MW
Hydraulic Generation	1,100 MW
Load Shifting	1,000 MW
Cogeneration	260 MW
Municipal Waste	50 MW
Small Hydraulic	50 MW

Hydro confirms that the detailed first progress report remained current.

Future Abatement Measures

Anticipating the necessity to retro-fit flue gas desulphurization (FGD) equipment on selected existing coal-fired generating stations starting in the mid-1990's. Hydro has authorized an expenditure of $7.7 million for research and the preparation of a program Environmental Assessment for a flexible program to install FGD equipment on up to 20 fossil generating units, including four different FGD technologies.

ONTARIO GOVERNMENT RESPONSE TO HYDRO'S SECOND PROGRESS REPORT

Hydro's voluntary submission of technical data, as requested by the Ministry of the Environment, was greatly appreciated. The quarterly reports on actual emissions have satisfied the requirements of the regulation, and the comparison of these numbers with historical patterns is useful. Hydro's 1986 emissions were well within the abatement requirements of Regulation 662/85.

The Minister of the Environment's position with Hydro (and with the other major sources) has been that his role is to set the emission limits, and Hydro's role is to find the appropriate abatement methods. This is particularly relevant in that Hydro's main line of responsibility runs up to the Ontario Minister of Energy.

Ontario Hydro has indicated that it is relying upon the currently approved generation mix as the major method of meeting emission limits in the next few years.

But in the mid-1990's, Ontario Hydro has forecast a recovery in coal-fired generation to pre-1986 levels and beyond. In order to address a recovery in coal-fired generation in the mid-1990's Hydro has four desulphurization techniques under intensive review and has initiated proceedings to develop a "Program Environmental Assessment".

While desulphurization techniques may provide a partial solution, several other options under consideration (not addressed in the first report), are briefly addressed in the second report (conservation, large and small hydraulic generation, load shifting, cogeneration and municipal solid waste).

Hydro still has not discussed in this forum the potential use of natural gas to "back out" future coal combustion. The Hearn generating station is already equipped to burn natural gas. Other coal stations presumably could be converted. With natural gas prices dropping, Ontario Hydro's consideration of this alternative should be discussed.

Also Hydro should discuss the current status of its review of the possible increased use of low sulphur coal from Western Canada, as a means of reducing SO_2 emissions when coal use increases again in the mid-1990's.

February 1987